PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
SRIDHAR GOLLAMUDI

Serial No.: 09/851,858

Filed: May 9, 2001

For: METHOD FOR MULTIPLE ANTENNA TRANSMISSION USING PARTIAL CHANNEL KNOWLEDGE

Examiner: J. PERILLA

Group Art Unit: 2635

Att'y Docket: 2100.012200

Customer No. 46290

APPEAL BRIEF

Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Appellant hereby submits this Second Appeal Brief to the Board of Patent Appeals and Interferences in response to the Notice of Non-Compliant Appeal Brief dated March 6, 2007. A response to said Notice of Non-Compliant is due April 6, 2007 and so this Appeal Brief is timely filed.

It is believed that no fee is due. The fee of $500.00 was previously paid. However, should additional fees be required the Commissioner is authorized to deduct the fee from **Williams, Morgan & Amerson's P.C. Deposit Account 50-0786/2100.012200.**

I. REAL PARTY IN INTEREST

The present application is owned by Lucent Technologies, Inc. The assignment of the present application to Lucent Technologies, Inc., is recorded at Reel 11807, Frame 0733.

II. RELATED APPEALS AND INTERFERENCES

Appellant is not aware of any related appeals and/or interferences that might affect the outcome of this proceeding.

III. STATUS OF THE CLAIMS

Claims 1-36 are pending in the application. In the Advisory Action mailed August 22, 2006, the Examiner indicated that claims 11-13, 16-19, and 21-28 are in condition for allowance. Claims 1-2, 4-6, 8-9, and 14-15 stand rejected under 35 U.S.C. § 103(a) as allegedly being obvious over Harrison (U.S. Patent No. 6,154,485) in view of Kalliojarvi (U.S. Patent No. 6,121,927). Claims 3, 7, 20, 29-33, and 35-36 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Harrison and Kalliojarvi in view of Alamouti (U.S. Patent No. 6,185,258). Claim 10 stands rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Harrison and Kalliojarvi in view of Dabak, et al (U.S. Patent No. 6,594,473). Claim 34 stands rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Harrison and Kalliojarvi in view of Alamouti and in further view of Rice (U.S. Patent Application Publication No. 2002/0172260).

IV. STATUS OF AMENDMENTS

In a response to the Final Office Action mailed May 10, 2005, Appellant proposed rewriting claims 11, 16, and 32 in independent form including all the limitations of the base claim and any intervening claims. Appellants also proposed amending other claims to address certain alleged informalities, as suggested by the Examiner. In the Advisory Action mailed August 22, 2006, the Examiner indicated that the proposed amendments have been entered.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Independent claims 1, 4, 8, 21-23, and 26-29 set forth, among other things, generating a transformation matrix and/or a code correlation parameter based on an auto-correlation of a channel estimate. See Patent Application, page 9, ll. 22-32. Appellant notes that the auto-correlation function is a well-known mathematical function that may be defined as the expected value of the product of a random variable or signal realization with a time-shifted version of itself. For example, the autocorrelation of a pair of random variables from the same process, $X_1=X(t_1)$ and $X_2=X(t_2)$, may be written as

$$\begin{aligned} R_{xx}(t_1,t_2) &= E[X_1X_2] \\ &= \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} x_1x_2f(x_1,x_2)\,dx_2dx_1 \end{aligned}$$

Thus, an autocorrelation function is applied to a *single* signal and/or data stream and not to two *different* signals and/or data streams.

The autocorrelation function may also be compared to the general definition of the correlation function. The correlation function between two time series X and Y is given by the expression

$$C(X, Y) = \frac{\langle (X - \mu_X)(Y - \mu_Y) \rangle}{\sigma_X \sigma_Y}$$

where μ_X (μ_Y) and σ_X (σ_Y) are the mean and variance estimates of X (Y) respectively, and $\langle \cdots \rangle$ denotes the mean value of the expression inside the brackets. The autocorrelation function is calculated by setting $Y = X(t + \delta)$, where δ is some forward time lag of the time series X. Hence, the autocorrelation function may be expressed as

$$C(\delta) = \frac{\langle [X(t)\, X(t + \delta)] \rangle - \mu_X^2}{\sigma_X^2}.$$

Thus, the autocorrelation function differs from a general correlation function in that the autocorrelation function is applied to a *single* signal and/or data stream and not to two *different* signals and/or data streams. The autocorrelation function is also discussed in numerous textbooks, *e.g.*, Bracewell, "The Autocorrelation Function," *The Fourier Transform and Its Applications, 3rd ed.* New York: McGraw-Hill, pp. 40-45, 1999.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Appellant respectfully requests that the Board review and overturn the five rejections present in this case. The following issues are presented on appeal in this case:

(A) Whether claims 1-2, 4-6, 8-9, and 14-15 are obvious over Harrison in view of Kalliojarvi;

(B) Whether claims 3, 7, 20, 29-33, and 35-36 are obvious over Harrison and Kalliojarvi in view of Alamouti;

(C) Whether claim 10 is obvious over Harrison and Kalliojarvi in view of Dabak; and

(D) Whether claim 34 is obvious over Harrison and Kalliojarvi in view of Alamouti and in further view of Rice.

VII. ARGUMENT

A. Legal Standards

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, the prior art reference (or references when combined) must teach or suggest all the claim limitations. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (CCPA 1974). Second, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. That is, there must be something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination. *Panduit Corp. v. Dennison Mfg. Co.*, 810 F.2d 1561 (Fed. Cir. 1986). In fact, the absence of a suggestion to combine is dispositive in an obviousness determination. *Gambro Lundia AB v. Baxter Healthcare Corp.*, 110 F.3d 1573 (Fed. Cir. 1997). The mere fact that the prior art can be combined or modified does not make the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 U.S.P.Q.2d 1430 (Fed. Cir. 1990); M.P.E.P. § 2143.01. Third, there must be a reasonable expectation of success.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991); M.P.E.P. § 2142. A recent Federal Circuit case emphasizes that, in an obviousness situation, the prior art must disclose each and every element of the claimed invention, and that any motivation to combine or modify the prior art must be based upon a suggestion in the prior art. *In re Lee*, 61 U.S.P.Q.2d 143 (Fed. Cir. 2002). Conclusory statements regarding common knowledge and common sense

are insufficient to support a finding of obviousness. *Id*. at 1434-35. Moreover, it is the claimed invention, as a whole, that must be considered for purposes of determining obviousness. A mere selection of various bits and pieces of the claimed invention from various sources of prior art does not render a claimed invention obvious, unless there is a suggestion or motivation in the prior art for the claimed invention, when considered as a whole.

It is by now well established that teaching away by the prior art constitutes *prima facie* evidence that the claimed invention is not obvious. *See, inter alia, In re Fine,* 5 U.S.P.Q.2d (BNA) 1596, 1599 (Fed. Cir. 1988); *In re Nielson*, 2 U.S.P.Q.2d (BNA) 1525, 1528 (Fed. Cir. 1987); *In re Hedges*, 228 U.S.P.Q. (BNA) 685, 687 (Fed. Cir. 1986).

B. Claims 1-2, 4-6, 8-9, and 14-15 Are Not Obvious over Harrison in view of Kalliojarvi.

Harrison is concerned with receiving signals using combined orthogonal transmit diversity and adaptive array techniques. Harrison describes a coefficient α that may allow a base transmitter to smoothly transition between orthogonal transmit diversity mode and adaptive array mode. This smooth transition may allow the base transmitter to smoothly disable the adaptive array mode in proportion to the degradation of the quality of feedback data from a receiver. See Harrison, col. 8, ll. 23-35. However, as admitted by the Examiner, Harrison does not describe or suggest determining a code correlation parameter (λ) based on an auto-correlation of a channel estimate.

Kalliojarvi describes correlating a channel estimate associated with the received signal with a reference channel estimate. The Examiner alleges that this may be considered an autocorrelation because the channel estimate is correlated with a reference version of itself. In

particular, the Examiner states that the reference signal described by Kalliojarvi is one of the multipaths of the received signal and therefore the correlation described by Kalliojarvi is an autocorrelation. Appellant respectfully disagrees.

As previously stated, an autocorrelation function is applied to a single signal and/or data stream and not to two different signals and/or data streams. Although each of the multipath signals received by the antennas in the antenna array may reflect portions of a single signal transmitted by a transmitter, the multipath signals are not the same signal. To the contrary, as is well known in the art and as has been recognized in the references cited by the Examiner, the multipath signals received by the antennas in the antenna array are different signals that traveled from the transmitter to the antenna by different paths. For example, the multipath signals typically have different propagation times from the transmitter to the antenna and may experience different (potentially frequency-dependent) fading so that the received signals differ from the transmitted signals, *i.e.* the received signals have been dispersed. In fact, Kalliojarvi teaches that it is the differences between the dispersed multipath signals that may permit the bearing of the received signal to be determined. See, e.g., Kalliojarvi, col. 2, line 62 – col. 3, line 5. Consequently, Appellant maintains that Kalliojarvi teaches performing a cross-correlation of the multipath signals received by the antennas in the antenna array. Accordingly, Appellant respectfully submits that Kalliojarvi does not teach or suggest the use of an autocorrelation function.

To establish a *prima facie* case of obviousness, the prior art reference (or references when combined) must teach or suggest all the claim limitations. Neither Harrison nor Kalliojarvi describes or suggests the use of an autocorrelation function, as set forth in independent claims 1, 4, and 8. Accordingly, Appellant respectfully submits that the prior art references fail to teach or

suggest all of the limitations of the claimed invention. Furthermore, Harrison is completely silent with regard to performing any type of correlation function and Kalliojarvi teaches that the channel estimate and the reference channel estimate should be cross-correlated to determine the bearing of a received signal. Accordingly, the combined references fail to teach each and every element of the claims, or to provide any suggestion or motivation to modify the prior art to arrive at the claimed invention, and are therefore not the proper basis for an obviousness rejection. Appellant respectfully submits that the Examiner has failed to make a *prima facie* case that the present invention is obvious over Harrison in view of Kalliojarvi and request that the Examiner's rejections of claims 1-2, 4-6, 8-9, and 14-15 be REVERSED.

C. Claims 3, 7, 20, 29-31, and 35-36 are not obvious over Harrison and Kalliojarvi in view of Alamouti.

As discussed above, neither Harrison nor Kalliojarvi describes or suggests the use of an autocorrelation function, as set forth in independent claims 1, 4, 8, and 29. To the contrary, Harrison is completely silent with regard to performing any type of correlation function and Kalliojarvi teaches that the channel estimate and the reference channel estimate should be cross-correlated to determine the bearing of a received signal.

The Examiner relies upon Alamouti to describe generation of an orthogonal code matrix. However, Alamouti fails to remedy the fundamental deficiencies of Harrison and Kalliojarvi. Moreover, none of the cited references provide any suggestion or motivation to modify the prior art to arrive at the claimed invention. For at least the aforementioned reasons, Appellant respectfully submits that the present invention is not obvious over Harrison, Kalliojarvi, and

Alamouti, either alone or in combination. Appellant requests that the Examiner's rejections of claims 3, 7, 20, 29-31 and 35-36 under 35 U.S.C. 103(a) be <u>REVERSED</u>.

D. <u>Claim 10 is not obvious over Harrison and Kalliojarvi in view of Dabak</u>.

Claim 10 depends from claim 8. As discussed above, neither Harrison nor Kalliojarvi describes or suggests the use of an autocorrelation function, as set forth in independent claim 8. To the contrary, Harrison is completely silent with regard to performing any type of correlation function and Kalliojarvi teaches that the channel estimate and the reference channel estimate should be <u>cross-correlated</u> to determine the bearing of a received signal.

The Examiner relies upon Dabak to describe a complex beamforming weight parameter having a magnitude and a phase. However, Dabak fails to remedy the fundamental deficiencies of Harrison and Kalliojarvi. Moreover, none of the cited references provide any suggestion or motivation to modify the prior art to arrive at the claimed invention. For at least the aforementioned reasons, Appellant respectfully submits that the present invention is not obvious over Harrison, Kalliojarvi, and Dabak, either alone or in combination. Appellant requests that the Examiner's rejections of claim 10 under 35 U.S.C. 103(a) be <u>REVERSED</u>.

F. <u>Claim 34 is not obvious over Harrison and Kalliojarvi in view of Alamouti and in further view of Rice</u>.

Claim 34 depends from claim 29. As discussed above, neither Harrison nor Kalliojarvi describes or suggests the use of an autocorrelation function, as set forth in independent claim 29. To the contrary, Harrison is completely silent with regard to performing any type of correlation

function and Kalliojarvi teaches that the channel estimate and the reference channel estimate should be cross-correlated to determine the bearing of a received signal.

The Examiner relies upon Rice to describe using a look up table and Alamouti to describe generation of an orthogonal code matrix.. However, Alamouti and Rice fail to remedy the fundamental deficiencies of Harrison and Kalliojarvi. Moreover, none of the cited references provide any suggestion or motivation to modify the prior art to arrive at the claimed invention. For at least the aforementioned reasons, Appellant respectfully submits that the present invention is not obvious over Harrison, Kalliojarvi, Alamouti, and Rice, either alone or in combination. Appellant requests that the Examiner's rejection of claim 34 under 35 U.S.C. 103(a) be REVERSED.

VIII. CLAIMS APPENDIX

The claims that are the subject of the present appeal – claims 1-36 – are set forth in the attached "Claims Appendix."

IX. EVIDENCE APPENDIX

There is no separate Evidence Appendix for this appeal.

X. RELATED PROCEEDINGS APPENDIX

There is no Related Proceedings Appendix for this appeal.

XI. CONCLUSION

In view of the foregoing, it is respectfully submitted that the Examiner erred in not allowing all claims pending in the present application, claims 1-36, over the prior art of record.

The undersigned may be contacted at (713) 934-4052 with respect to any questions, comments or suggestions relating to this appeal.

Respectfully submitted,

Date: March 29, 2007

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AGENT FOR APPLICANT

CLAIMS APPENDIX

1. (Previously Presented) A method of encoding information symbols for multiple antennae transmission comprising the steps of:

generating a code matrix B_0;

generating a transformation matrix L based on an auto-correlation of a channel estimate; and

combining the code matrix B_0 with the transformation matrix L to obtain a result B for controlling the amount of beamforming relative to the amount of orthogonal coding in signals transmitted from the multiple antennae.

2. (Previously Presented) The method of claim 1 wherein the transformation matrix L is a matrix such that the conjugate transpose of L multiplied by L generates a desired correlation matrix Φ.

3. (Original) The method of claim 2 wherein the code matrix B_0 is orthogonal.

4. (Previously Presented) A method of encoding information symbols for multiple antennae transmission comprising the steps of:

generating a code matrix B_0;

generating a transformation matrix L based on an auto-correlation of a channel estimate, where L satisfies the relationship $\Phi = L^H L$, and where Φ is a desired correlation matrix and H indicates a conjugate transpose; and

combining the code matrix B_0 with the transformation matrix L to obtain a result B for controlling the amount of beamforming relative to the amount of orthogonal coding in signals transmitted from the multiple antennae.

5. (Original) The method of claim 4 wherein the desired correlation matrix is comprised of at least one correlation parameter λ .

6. (Original) The method of claim 5 wherein the transformation matrix L is the matrix square root of the desired correlation matrix Φ.

7. (Original) The method of claim 4 wherein blocks of symbols of a serial data stream of user data are encoded with an orthogonal code to form code matrix B0.

8. (Previously Presented) A method of generating signals for transmitting from at least two antennae of a wireless communications system comprising the steps of:

feeding a stream of incoming information symbols to an encoder;

feeding a signal representative of a beamforming weight parameter to the encoder to modify the stream of information symbols;

determining a code correlation parameter (λ) based on an auto-correlation of a channel estimate;

feeding the code correlation parameter (λ) to the encoder to control the proportion of orthogonal coding relative to beamforming applied to the stream of information symbols that are to be transmitted; and

feeding the stream of information symbols modified by the code correlation parameter to at least two antennae for transmission.

9. (Original) The method of claim 8 wherein the code correlation parameter determines the correlation of the encoded signals to the different antennae.

10. (Original) The method of claim 9 wherein the signal representative of the beamforming weight parameter represents a complex number having a magnitude and a phase.

11. (Previously Presented) A method of generating signals for transmitting from at least two antennae of a wireless communications system comprising the steps of:

feeding a stream of incoming information symbols to an encoder;

feeding a signal representative of a beamforming weight parameter to the encoder to modify the stream of information symbols, wherein the signal representative of the beamforming weight parameter represents a complex number having a magnitude and a phase;

determining a code correlation parameter (λ) based on an auto-correlation of a channel estimate, wherein the code correlation parameter determines the correlation of the encoded signals to the different antennae;

feeding the code correlation parameter (λ) to the encoder to control the proportion of orthogonal coding relative to beamforming applied to the stream of information symbols that are to be transmitted; and

feeding the stream of information symbols modified by the code correlation parameter to at least two antennae for transmission

wherein the signal representative of the beamforming weight parameter is a real number portion of a phase of the beamforming weight parameter.

12. (Previously Presented) The method of claim 11 wherein the code correlation parameter is a real number that can vary between a first value and a second value.

13. (Original) The method of claim 12 wherein one of the values represents orthogonal coding with no beamforming and the other value represents beamforming with no orthogonal coding, and intermediate values represent a combination of orthogonal coding and beamforming.

14. (Original) The method of claim 9 wherein, in a duplex communication system having a forward and reverse link, the code correlation parameter is determined from signals received on the reverse link.

15. (Original) The method of claim 14 further comprising the step of determining a channel correlation coefficient (ρ) from the signals received on the reverse link.

16. (Previously Presented) A method of generating signals for transmitting from at least two antennae of a wireless communications system comprising the steps of:

feeding a stream of incoming information symbols to an encoder;

feeding a signal representative of a beamforming weight parameter to the encoder to modify the stream of information symbols;

determining a code correlation parameter (λ) based on an auto-correlation of a channel estimate, wherein the code correlation parameter determines the correlation of the encoded signals to the different antennae, and wherein, in a duplex communication system having a forward and reverse link, the code correlation parameter is determined from signals received on the reverse link;

determining a channel correlation coefficient (ρ) from the signals received on the reverse link wherein the channel correlation coefficient (ρ) is a complex number from which the magnitude component and not the phase component is used to determine the code correlation parameter λ;

feeding the code correlation parameter (λ) to the encoder to control the proportion of orthogonal coding relative to beamforming applied to the stream of information symbols that are to be transmitted; and

feeding the stream of information symbols modified by the code correlation parameter to at least two antennae for transmission.

17. (Previously Presented) The method of claim 16 wherein the channel correlation coefficient is an estimate of an auto-correlation coefficient of channel gain from an antenna for a fixed time delay.

18. (Previously Presented) The method of claim 17 wherein the fixed time delay is determined by a difference between a time at which feedback information is transmitted on the reverse link to a time at which the beamforming weight parameter computed using that information is applied by a forward link transmitter.

19. (Previously Presented) The method of claim 18 wherein the fixed time delay is equal to the time difference multiplied by a ratio of carrier frequencies on the reverse and forward links.

20. (Previously Presented) The method of claim 8 wherein the signal transmitted by each antenna at each symbol time is the sum of one or more signals, each of which is proportional to the product of one of the incoming information symbols and their complex conjugates and their negations and their negations of their complex conjugates, with a number that is determined by the code correlation parameter (λ).

21. (Previously Presented) A method of forming a signal comprising the steps of:

obtaining at least two component signals;

determining first and second complex numbers based upon an autocorrelation of a channel estimate;

multiplying a first component signal by the first complex number to obtain a first signal;

multiplying a second component signal by the second complex number to obtain a second signal, wherein the phases of the first and second complex numbers are unequal; and

combining the second signal and the first signal to obtain a first composite signal for transmission by a first antenna element during a first transmit period.

22. (Previously Presented) A method of forming signals for transmission from an antenna element during two transmit periods comprising the steps of:

obtaining at least two component signals for each transmit period;

multiplying a first component signal by a first complex number to obtain a first signal;

multiplying a second component signal by a second complex number to obtain a second signal, wherein the phases of the first and second complex numbers are unequal;

combining the second signal and the first signal to obtain a first composite signal for transmission by the first antenna element during a first transmit period;

multiplying a third component signal by the second complex number to obtain a third signal;

multiplying a fourth component signal by the first complex number to obtain a fourth signal; and

adding the third signal to the fourth signal to obtain a second composite signal for transmission by the antenna element during a second transmit period.

23. (Previously Presented) A method of forming signals for transmission from two antenna elements during two transmit periods comprising the steps of:

obtaining at least two component signals for each antenna for each time interval;

multiplying a first component signal by a first complex number to obtain a first signal;

multiplying a second component signal by a second complex number to obtain a second signal, wherein the phases of the first and second complex numbers are unequal;

combining the second signal and the first signal to obtain a first composite signal for transmission by a first antenna element during a first transmit period;

multiplying a third component signal by the second complex number to obtain a third signal;

multiplying a fourth component signal by the first complex number to obtain a fourth signal;

adding the third signal to the fourth signal to obtain a second composite signal for transmission by the first antenna element during a second transmit period;

multiplying the first component signal by a third complex number to obtain a fifth signal;

multiplying the second component signal by a fourth complex number to obtain a sixth signal, wherein the phases of the third and fourth complex numbers are unequal;

adding the fifth signal to the sixth signal to obtain a third composite signal for transmission by the second antenna element during the first transmit period;

multiplying the third component signal by the fourth complex number to obtain a seventh signal;

multiplying the fourth component signal by the third complex number to obtain an 8th signal; and

subtracting the seventh signal from the 8th signal to obtain a fourth composite signal for transmission by the second antenna element during the second transmit period.

24. (Previously Presented) The method of claim 23 wherein the at least two component signals are determined by at least one incoming information symbol and at least one of the component signals is related to a code correlation parameter.

25. (Original) The method of claim 24 wherein each component signal is related to at least one of two information symbols, or their negations, or their complex conjugates or the negations of their complex conjugates.

26. (Previously Presented) A method of forming a signal comprising the steps of:

obtaining at least two component signals;

determining first and second phases based upon an autocorrelation of a channel estimate;

applying the first phase to a first component signal to obtain a first signal;

applying the second phase to a second component signal to obtain a second signal, wherein the first and second phases are unequal; and

combining the second signal and the first signal to obtain a first composite signal for transmission by a first antenna element during a first transmit period.

27. (Previously Presented) A method of forming signals for transmission from an antenna element during two transmit periods comprising the steps of:

obtaining at least two component signals for each transmit period;

applying a first phase to a first component signal to obtain a first signal;

applying a second phase to a second component signal to obtain a second signal, wherein the first and second phases are unequal;

combining the second signal and the first signal to obtain a first composite signal for transmission by the first antenna element during a first transmit period;

applying the second phase to a third component signal to obtain a third signal;

applying the first phase to a fourth component signal to obtain a fourth signal; and

combining the third signal and the fourth signal to obtain a second composite signal for transmission by the antenna element during a second transmit period.

28. (Previously Presented) A method of forming signals for transmission from two antenna elements during two time intervals comprising the steps of:

obtaining at least two component signals for each antenna for each time interval;

applying a first phase to a first component signal to obtain a first signal;

applying a second phase to a second component signal to obtain a second signal, wherein the first and second phases are unequal;

combining the second signal and the first signal to obtain a first composite signal for transmission by a first antenna element during a first time interval;

applying the second phase to a third component signal to obtain a third signal;

applying the first phase to a fourth component signal to obtain a fourth signal;

combining the third signal and the fourth signal to obtain a second composite signal for transmission by the first antenna element during a second time interval;

applying a third phase to the first component signal to obtain a fifth signal;

applying a fourth phase to the second component signal to obtain a sixth signal, wherein third and fourth phases are unequal;

combining the fifth and sixth signals to obtain a third composite signal for transmission by the second antenna element during the first transmit period;

applying the fourth phase to the third component signal to obtain a seventh signal;

applying the third phase to the fourth component signal to obtain an 8th signal; and

combining the fifth signal and the sixth signal to obtain a fourth composite signal for transmission by the second antenna element during the second time interval.

29. (Previously Presented) A method of encoding information symbols for multiple antenna transmission comprising the steps of:

determining a plurality of orthogonal codes;

estimating at least one autocorrelation of at least one channel; and

determining an amount of the beamforming relative to an amount of orthogonal coding and signals transmitted from the multiple antenna based upon the plurality of orthogonal codes and the at least one autocorrelation.

30. (Previously Presented) The method of claim 29, wherein determining the plurality of orthogonal codes comprises determining a code matrix, and wherein each column of the code matrix is associated with one of the plurality of orthogonal codes such that the columns are orthogonal to each other.

31. (Previously Presented) The method of claim 29, wherein estimating the at least one autocorrelation of the at least one channel comprises estimating at least one autocorrelation of at least one reverse link channel.

32. (Previously Presented) The method of claim 29, wherein estimating the at least one autocorrelation comprises determining at least one round-trip delay associated with the at least one channel.

33. (Previously Presented) The method of claim 32, wherein estimating the at least one autocorrelation comprises determining at least one autocorrelation of the at least one channel for the at least one round-trip delay.

34. (Previously Presented) The method of claim 29, wherein determining the amount of beamforming relative to the amount of orthogonal coding comprises accessing a lookup table.

35. (Previously Presented) The method of claim 29, comprising encoding at least one symbol using the determined amount of beamforming and orthogonal coding.

36. (Previously Presented) The method of claim 35, comprising transmitting the at least one encoded symbol using the determined amount of beamforming and orthogonal coding.